NORTHERN COASTAL SCRUB ON POINT REYES PENINSULA, CALIFORNIA

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According to Munz (1959) and Ornduff (1974), northern coastal scrub extends in a narrow coastal strip from southern Oregon to Point Sur, Monterey County. The vegetation type has recently been reviewed by Heady et al. (1977), who showed it to be a discontinuous community within a grassland matrix, dominated either by *Baccharis pilularis* var. *consanguinea* or *Lupinus arboreus*. Few quantitative studies for the type exist. The grassland-scrub mosaic is complex, and Howell (1970) pointed out that the scrub ". . . is perhaps the least definite in its boundaries . . ." of any Marin County community.

Our objective was to document quantitatively the composition and structure of northern coastal scrub for an area representative of its range. Point Reyes Peninsula was selected as the study site because of its proximity to Davis, its topographic and soil diversity, its protected (National Park) status, and its relatively well-known land-use history. Within the Peninsula, major sample areas were on the slopes of Mt. Vision and near Laguna Ranch (Fig. 1). The elevation of Mt. Vision sites made the vegetation typical of scrub to the north, in the center of its distributional range. Additional, minor sample areas were near Tomales Point and in Tomales State Park.

Description of the Area

The climate of Pt. Reyes Peninsula is Mediterranean, modified by a maritime influence. It is characterized by cool, foggy but otherwise dry summers and cool, wet winters.

Temperature and rainfall data were obtained from unpublished National Park Service records from the Bear Valley Weather Station (24 m elevation) for 1964–75. Due to topography, annual rainfall varies markedly within short distances, but only sporadic climatic records exist for the Mt. Vision area (395 m), and this prohibits comparison between our high and low elevation sample sites. Mean annual precipitation at Bear Valley was 1,052 mm over the 11-yr. period, with the greatest amount occurring October through April. The driest months are July-September and total rainfall then averages 7 mm. According to Howell (1970), the average annual temperature is 11.4°C. The range of average temperature from warmest to coldest months is less than 2°C, although the extremes have ranged from 38.9°C (September, 1971) to − 9.4°C (December, 1972) at Bear Valley. Sub-freezing temperatures occur anytime from October to May but are infrequent and seldom include hard frosts. Prevailing winds are WNW.

Pt. Reyes is gently rolling to hilly; elevation ranges from sea level to 435 m on Mt. Wittenburg. Inverness Ridge, averaging 300 m, runs parallel to Tomales Bay from Tomales Point south to the Park boundary and beyond. Ocean-facing cliffs, about 20–50 m high, are common along most of Drakes Bay and the Pacific Ocean coast.

The vegetation was mapped by Donald Lauer in 1973 (Point Reyes National Seashore, 1973), and his map shows a mosaic of coastal prairie, northern coastal scrub, closed-cone pine forest, mixed evergreen forest, and localized patches of dune scrub close to shore.

Point Reyes Peninsula is joined to the mainland along the San Andreas Fault. According to Howell (1970) and Feray et al. (1968), the peninsula is composed of three major geologic formations. The NE quarter and the tip of the point is Montara granitic formation of Mesozoic origin. The SE half of the peninsula is Monterey shale formation of Miocene origin. Some stabilized sand dune deposits overlay the Monterey shale in the central coastal portion.

The U.S. Soil Survey is in the process of mapping soil types of Point Reyes Peninsula. Through personal communication with Gordon Shipman of the Marin County Soil Survey staff, we were able to define the general soil types of the primary study locations. The soil of Mt. Vision sites is a clay loam, over a clay hardpan, about 50–100 cm deep, over quartz diorite parent material. It is similar to the Auberry series as defined by the National Cooperative Soil Survey (NCSS). Soil at the Laguna Ranch sites is a shaley clay loam, over shaley clay, about 50–100 cm deep, over shale parent material. It is similar to the NCSS Santa Lucia series in color, and in shallowness it is much like the NCSS Lopez series. The soil at Tomales State Park is a coarse sandy loam up to 1.5 m deep. It has developed on a stabilized sand dune deposit and is similar to the NCSS Sheridan series. We have no data for soil beneath the Tomales Point site.

Selection of Sample Sites and Sampling Method

Sampling areas were chosen because they represent, with one exception, undisturbed, extensive, distinct examples of northern coastal scrub. The exception was a site on Tomales Point in an area actively grazed by cattle. The areas provided a variety of slope, aspect, soil type, and elevation which seemed to include the full range of habitat occupied by the vegetation type.

The method of sampling was by line transect. A total of 20 transects was established at 15 different sites (Fig. 1). Transects were 20 m long, but sometimes they were subdivided into two smaller units and placed apart from each other, depending on homogeneity of the site. Preliminary observations indicated that a length of 15 m included most variability and gave a representative sample. Within a given site, transects were subjectively located after reconnaisance. Plant cover of each species

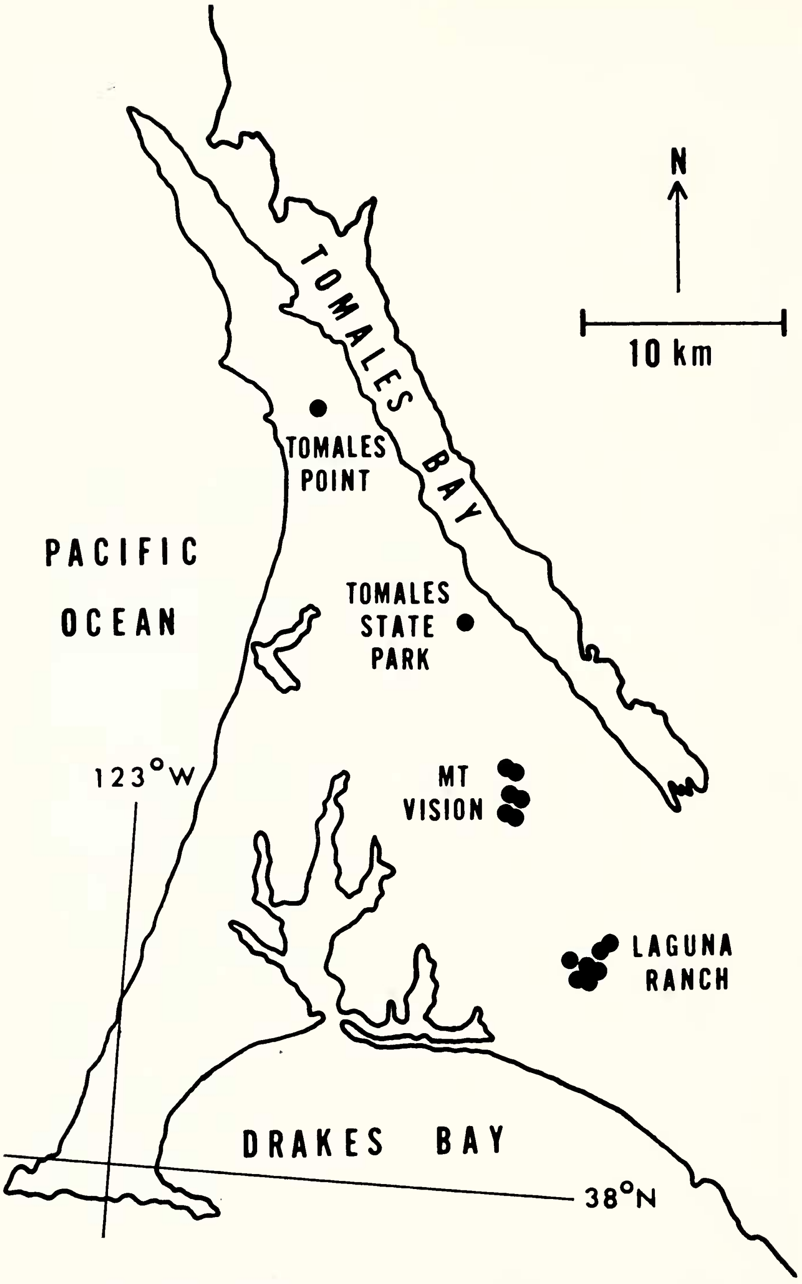

FIG. 1. Point Reyes Peninsula and location of northern coastal scrub sampling sites (dots).

TABLE 1. ABSOLUTE COVER (%) OF ALL SPECIES ENCOUNTERED ON 15 NORTHERN COASTAL SCRUB SITES ON POINT REYES PENINSULA. t < 0.1% cover.

Taxa	Average	"N-facing"	"S-facing"
Anaphalis margaritacea	0.3	0.5	....
Artemisia californica	2.7	....	6.0
Baccharis pilularis var. *consanguinea*	31.2	25.7	38.0
Corylus cornuta	3.1	5.5	....
Elymus condensatus	2.0	3.5	0.1
Erechtites prenanthoides	0.3	0.3	0.2
Fragaria californica	0.4	0.6	0.3
Galium nuttallii	0.5	0.2	0.8
Gaultheria shallon	3.9	7.0	....
Heracleum lanatum	1.6	1.6	1.6
Holodiscus discolor	0.1	0.2	....
Lupinus arboreus	t	0.1	....
Mimulus aurantiacus	7.0	1.0	14.5
Picris echioides	t	0.1	....
Polystichum munitum	28.6	44.5	8.4
Pteridium aquilinum	6.4	3.5	10.0
Rhamnus californica	20.1	4.3	40.0
Rhus diversiloba	2.2	0.2	4.6
Rubus ursinus and/or *R. vitifolius*	5.8	3.6	8.7
Satureja douglasii	5.9	2.4	10.4
Stachys rigida	1.6	1.4	1.9
Total	123.8	110.2	145.5

along the transect was measured to the nearest 0.5 dm. Additional data recorded for each site were slope, aspect, average vegetation height, and a subjective evaluation of soil moisture conditions (very dry, dry, moist, wet, very wet). Any species not on the transect but occurring nearby was also noted. Since the study was conducted January-March, maximum cover of *Rhus* and some herbs could not be measured. Nomenclature follows Munz (1959) and voucher specimens are deposited in DAV.

DISCUSSION AND CONCLUSIONS

Our 15 transect sites ranged in elevation from 50 to 340 m, in slope aspect from 90° (due E) to 350° (NNW), and in steepness of slope from 26 to 80%. Inspection of cover data indicated that slope aspect had the greatest effect on community composition. Table 1 summarizes absolute cover by slope aspect category. "North-facing" here includes all slopes from 270° (due W) to 90° (due E) in orientation, and "south-facing" includes all other orientations.

North-facing slopes were dominated in the overstory by a rather open (26% cover) canopy about 1.5 m tall of *Baccharis pilularis* var. *consanguinea*. The understory, about 0.3 m tall, was dominated by *Polystichum* (45% cover), with *Gaultheria, Corylus, Pteridium, Rubus,* and *Elymus* species accounting for another 27% cover. It was essentially a two-layered community. There was less than 2% bare ground. South-facing slopes had shared dominance by *Baccharis* (38% cover) and *Rhamnus californica* (40% cover) in an overstory canopy about 1.0 m tall, with an understory dominated by *Mimulus, Satureja,* and *Pteridium* species. The southern affinity of this phase is shown by modest cover values for *Artemisia californica* and *Rhus diversiloba,* dominants of coastal sage scrub in the Monterey area (Heady et al. 1977). North-facing slopes exhibited less than 4% cover by deciduous species while south-facing slopes exhibited more than 13%, also illustrating affinity to the predominantly deciduous coastal sage scrub. Species richness was greater on north-facing slopes (total of 20 species encountered) than on south-facing slopes (15 species). There was twice as much bare ground beneath south-facing stands. Only a few species were completely restricted by slope aspect: *Anaphalis margaritacea, Corylus cornuta, Gaultheria shallon, Holodiscus discolor, Lupinus arboreus,* and *Picris echioides* were found only on north-facing slopes, and *Artemisia californica* was found only on south-facing slopes.

Additional, stand to stand variation was revealed by ordination. A

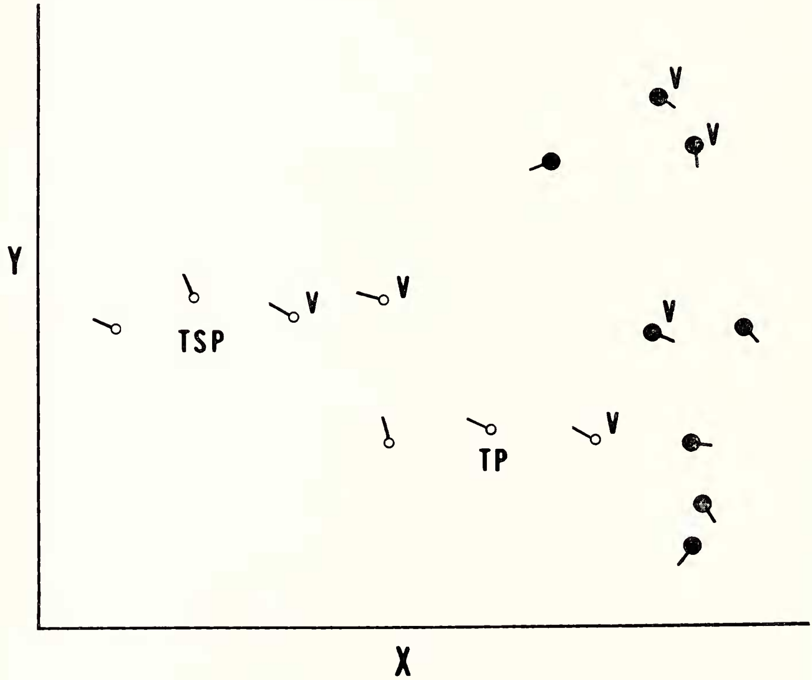

Fig. 2. Ordination of stands. For convenience, "north-facing" stands are indicated as o's, "south-facing" stands as dots. The actual aspect is indicated by the direction of the line away from each dot or o. Stands on Mt. Vision, Tomales Point and Tomales State Park are marked with a V, TP, TSP, respectively. Laguna Ranch sites are unmarked.

similarity index (S) for every pair of stands was calculated as $S = RC_S/200$, where RC_S is the sum of the smaller of the pair of relative cover values for each taxon, for all taxa common to the two stands being compared, and 200 is the sum of relative cover values for all taxa in stands A and B. This equation is Motyka's modification of Sorenson's Index (Mueller-Dombois and Ellenberg, 1974).

The matrix of similarity indices was displayed by a polar ordination method of Bray and Curtis (Cottam et al. 1974), with three mutually orthogonal axes, X, Y, and Z.

The ordination of stands on X and Y axes is shown in Fig. 2 (these two axes accounted for 79% of stand-stand variation, and the Z axis gave very little additional spread of stands). The X axis correlates with our subjective moisture assessments of stands. Relatively mesic, north-facing stands on the left grade into relatively dry, south-facing, lower elevation stands on the right. The Y axis, however, which adds considerable spread to the south-facing stands, does not correlate well with any of the other environmental factors that we recorded (steepness of slope, land-use history, soil type, elevation). Degree of exposure to prevailing winds (a combination of aspect, nearness to the Pacific Ocean, and openness of the site to air movement) accounts for some of the spread on the Y axis. (Subjectively, we noticed that canopy height was lowest on the windiest sites.)

We found no evidence that northern coastal scrub is seral to forest. In the Berkeley Hills, McBride and Heady (1968) and McBride (1974) reported that a *Baccharis* scrub was being invaded by elements of oak or mixed evergreen forest. At Point Reyes National Seashore, Research Biologist Richard M. Brown believes the scrub may be seral to closed-cone pine forest (pers. comm.). Although we did find an occasional tree of *Umbellularia californica, Pseudotsuga menziesii, Quercus agrifolia,* or *Pinus muricata* in the midst of scrub, we saw no seedlings or saplings.

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STATUS OF ALLIUM SERRATUM (LILIACEAE) AND DESCRIPTION OF A NEW SPECIES

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In 1871, Watson described "Allium serratum" from California. In the protologue he cited ten collections and listed *Allium amplectens* Torr. (1865) as a synonym, indicating that its type (Sonoma, 3 May 185–, *Bigelow s.n.*, NY) "is a very young undeveloped state and the name is inapplicable to the mature plant". Application of the current rules of nomenclature (Arts. 62 and 63) makes "A. serratum" superfluous and illegitimate. Later Watson (1879) reconsidered his circumscription of "A. serratum". Here he cited *A. amplectens* Torr. as a synonym of *A. attenuifolium* Kell. (1863). (We agree that the types of these names are conspecific; however, the correct name is *A. amplectens* Torr.) "Allium serratum" then apparently referred to a taxon represented by the syntypes originally cited in 1871.

During investigation into the taxonomy of the *Allium acuminatum* alliance to which "A. serratum" has been referred (Saghir et al., 1966) we studied all but four (*Bolander s.n., Douglas s.n., Kellogg s.n.,* and *Wallace s.n.*) of those ten collections. We believe the six collections studied represent two species. Five (*Hartweg 1991,* GH, NY; *Fremont 469,* GH; *Bridges 345,* NY, US; *Stillman s.n.,* NY; *Rich, s.n.,* NY) correspond closely to Watson's original description and he annotated them "Allium serratum". The other specimen (Benecia, 1853–4, *Bigelow s.n.,* GH) does not match the original description and Watson seems to have recognized this since he annotated it "Allium serratum, form". This is reinforced by a specimen (*Kellogg 1012,* GH) that he annotated in the same manner but that was not cited among the syntypes. Later authors incorrectly applied the name "A. serratum" to these latter specimens disregarding the fact that they do not correspond to Watson's description nor his interpretation of what was "A. serratum" and what was a form of this species.